LIQUID CRYSTAL DISPLAY

Background of the Invention

The subject invention is directed to the liquid crystal display art and, more particularly, to a liquid crystal display apparatus wherein a housing thereof contains a display which functions as a liquid crystal cell, a support which is configured as a reflector, and a heating device for the display.

Liquid crystal displays in general are known in the art. In particular, in DE 44 17 990 A1, a light box is arranged behind a liquid crystal cell. A reverse side of the light box is bordered by a conductor plate provided with lights. A heating wire is located between the lights and the liquid crystal cell so that the liquid crystal cell itself can be selectively heated if temperatures are too low.

Further, in DE 41 40 415 A1, a liquid crystal display is described. The liquid crystal display is provided with a liquid crystal cell having a transparent thin layer heating unit.

One drawback in prior art devices in general, and in the known liquid crystal displays described above particularly, is a high construction cost attributable mainly to the requirement of assuring that the liquid crystal cell is heated at low temperatures.

It would be desirable, therefore, to provide a low cost liquid crystal display of the type described above and with a liquid crystal cell which is heatable at low temperatures in a functionally safe and low cost manner.

Summary of the Invention

The subject invention provides a new and improved liquid crystal apparatus display which is inexpensive to manufacture and which includes a display functioning as a liquid crystal cell. The display of the subject apparatus is

heatable at low temperatures in a functionally safe manner.

In particular, and in accordance with one aspect of the invention, the heating device is a metallic layer applied directly onto a support member. The metallic layer beneficially serves as a resistance heating device. By means of the construction of the metallic layer applied directly onto the support, the installation of additional components to heat the liquid crystal cell becomes unnecessary.

In accordance with another aspect of the invention, in order to provide the support with the metallic layer, several methods are employed. First, a support member functioning as a reflector is coated with a bonding layer as a primer and is subsequently covered with a galvanic coating.

In another form, a foil is coated with the primer bonding layer and subsequently galvanic coated by deep-drawing the foil and subsequent rear-spraying of the foil in the support member.

According to yet another aspect of the invention, the manufacture of the support member from two kinds of plastic is effected preferably by a two-component spray method. Thus, a first portion of the support member is manufactured from a plastic material which cannot be metal-coated, and a second portion from a plastic material which can be coated with metal. A subsequent partial metal chemical metal-coating of the second portion of the support member is performed as a manufacturing step.

Still further in accordance with the invention, selected plastic components are radiated with a short-wave, ultra-violet light of an excimer lamp or an excimer laser. The radiated plastic is immersed in a watery solution with subsequent further bath steps. The layers applied in such a manner are selectively electrically contacted and galvanically reinforced to a customary thickness for conductor tracks.

In the galvanic coating steps identified above, the

coating layers are preferably copper.

In accordance with yet another aspect of the invention, electrical contacting is selectively performed using suitable mechanical pins, preferably made of metal, injected into the support member, or by soldering metal-coated plastic surfaces directly with an associated conductor plate.

In accordance with a further embodiment of the invention, the housing and support member with the metallic provided as a heating device are formed as a single piece unitary construction. This results in a significant simplification in design and resultant reduction in costs.

Still other advantages and benefits of the invention will become apparent to those skilled in the art upon a reading and understanding of the following detailed description.

Brief Description of the Drawings

The invention may take physical form in certain parts and arrangement of parts, the preferred embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof, and wherein:

FIGURE 1 is an exploded view of various elements of the liquid crystal display apparatus in accordance with a first embodiment of the present invention; and,

FIGURE 2 shows the subject liquid crystal display apparatus in accordance with a second embodiment of the invention.

Detailed Description of the Preferred Embodiments

The first preferred embodiment of the subject invention will be described with reference to Figure 1. As shown there, a display **1** functioning as a liquid crystal cell

is disposed within a housing **10**. In addition, a support member **2** functioning as a reflector is also disposed within the housing **10**. A dispersion foil **5** is located beneath the display **1** as illustrated. The dispersion foil **5** is arranged within the housing when the subject liquid crystal display apparatus is assembled. During assembly, an upper frame member **20** includes a plurality of tabs with recesses **15** which are selectively clipped together with corresponding catch tongues **25** provided on the outside of the housing member **10**.

In accordance with the invention, the reflective support member **2** is provided with a heating device for selectively heating the liquid crystal cells of the display **1**. Preferably, the heating device is a metallic layer **8** applied directly onto the support member **2**. In addition, a conductor plate **14** is provided as illustrated. The metallic layer is preferably produced by coating the plastic support member **2** with a bonding layer and by a subsequent galvanic coating step. The galvanic coating is preferably copper.

In accordance with an alternative preferred embodiment, the metallic layer is a foil member coated with a bonding layer and subsequently galvanically treated, whereby, thereafter, the foil is deep-drawn and joined with the support member **2** using a rear-spraying step.

In accordance with yet a further alternative preferred embodiment, the metallic layer is produced using a two-component spray process from a metal-coatable plastic and a non-coatable plastic with a subsequent partial chemical metal coating of the metal-coatable plastic portion of the support member.

Yet alternatively, selected locations or portions of the plastic element are radiated using a short-wave ultraviolet light of an excimer lamp or an excimer laser. Thereafter, the plastic is immersed in a watery solution,

whereby, in further bags within brief periods of time, a continuous copper or nickel layer is developed. These layers are selectively electrically contacted and galvanically reinforced to a customary thickness to provide suitable conductor tracks.

The metallic layer **8** is selectively equipped with suitable contact pins injected into the support member **2** which are formed, as an example, as mechanical metal pins. Alternatively, the contacting is effected directly using metallized plastic surfaces which are soldered together with the conductor plate.

With reference next to Figure 2, a single-piece embodiment of the subject liquid crystal display apparatus is illustrated. As shown there, the conductor plate or housing **10** is connected as a single piece with the support member **2** whereby the support **2** in turn presents a metallic layer **8** which forms a heating device functionally equivalent to that described above in connection with the first embodiment shown in Figure 1.

In accordance with the present invention, the heating device is a metallic layer **8** applied directly onto the support member **2**. This results in a significant simplification of the entire unit and a corresponding reduction in costs. These benefits are derived in part by avoidance of the need to install additional components to accomplish the heating function.